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(54) METHOD OF JOINING A LOW MELTING POINT MATERIAL WITH A HIGH MELTING POINT MATERIAL

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SPECIFICATION

1. TITLE OF THE INVENTION

METHOD OF JOINING A LOW MELTING POINT MATERIAL WITH A HIGH MELTING POINT MATERIAL

2. SCOPE OF PATENT CLAIMS

(1) A method of joining a low melting point material with a high melting point material, characterized in that a material having a low melting point and a material having a high melting point are placed in close proximity and a laser beam is fired at the surface of the side of the material with the low melting point.

(2) The method of joining a low melting point material with a high melting point material described in Claim 1 of the scope of patent claims wherein the low melting point material is aluminum, an aluminum alloy, zinc, a zinc alloy, magnesium, a magnesium alloy, phenol or similar polymer material and the high melting point material is stainless steel, molybdenum, tungsten die steel or a similar steel alloy.

3. DETAILED DESCRIPTION OF THE INVENTION

FIELD OF INDUSTRIAL APPLICATION

The present invention pertains to a method of joining a low melting point material with a high melting point material and pertains to a joining method that is simple, low-cost and contact-free while making highly precise positioning and assembly possible.

STRUCTURE OF PRIOR ART EXAMPLES AND PROBLEMS THEREOF

There are often times when a part comprised of a low melting point material and a part comprised of a high melting point material are joined, such as with an inclined post, as shown in Figure 1, that guides magnetic tape as it travels in a video tape recorder that is constituted by joining a shaft 2, which has a high-precision processed stainless steel surface, to a holder 1, which uses a die-cast aluminum material. When combining a part made with this sort of low melting point material with a part made from a high melting point material, a mechanical press-fitted crimping method is used because fixing the materials in place by soldering or brazing is problematic as the melting points of the two [materials] are significantly different. As shown in Figure 2, the diameter of the hole 11 in the holder 1 is processed to be slightly smaller or to have the same dimensions as the outside diameter of the shaft 2 and then this shaft 2 is forcibly inserted into the hole 11 in the holder 1.

In such cases, because the strength of the joint varies with the dimensional differences between the two objects, the dimensional tolerance of both parts has to be quite stringent in order to produce parts without variation in joint strength, which causes higher costs.

Additionally, the angle between the bottom surface 12 of the holder and the shaft 2 for this inclined post has to be highly precise. Therefore, in order to ensure that precision, first, the angle 4 of the die-cast aluminum holder 1 has to be highly precise,

and normally die-cast parts are subjected to a cutting process like reaming. This causes costs to go up even higher. Moreover, even if the holder 1 undergoes high-precision processing, the number of errors from deformations, etc. additionally accumulate when the shaft 2 is pressed into place, which causes low yields and makes the high-precision and low-cost assembling and joining of the parts extremely difficult.

PURPOSE OF THE INVENTION

This invention was developed to solve the types of problems of the prior art described above and its purpose is to provide a method of joining that can firmly position and join parts quickly, extremely easily, with a high degree of precision, and, moreover, in a short time, when assembling and joining a part made from a low melting point material and a part made from a high melting point material.

STRUCTURE OF THE INVENTION

In order to achieve these objectives, the present invention shapes the low melting point material and the high melting point material into predetermined shapes, places them in close proximity, and, in that state, fires a high-precision laser beam at one or more places on the surface of the low melting point material, joining them without making physical contact.

EXPLANATION OF THE EMBODIMENTS

An embodiment of the present invention is explained below, with reference to the figures.

Figure 3 shows the first embodiment of the present invention, in which the shaft 2, which is made from a material with a high melting point such as stainless steel and is formed so that its outside diameter is smaller than the diameter of the hole of the holder 1, which is made of a low-temperature material such as die-cast aluminum, is inserted into the hole of holder 1. At this point, there is a gap 8 between the shaft 2 and the hole in the holder 1. These two parts 1 and 2 are fixed in place by the high-precision positioning assembly jig 3. Thus, it is possible to ensure good reproducibility of the necessary precision after joining the two parts using the jig 3. The reference surface 5 of the jig for fixing the holder in place and the reference surface 6 for fixing the shaft in place are created at a specific angle, and the holder 1 and the shaft 2 are temporarily fixed at the required shape precision using such means as tightening with springs or screws. By firing a laser beam 7 at one or more places on the outer surface of the holder 1 in this state, both parts will be joined completely. In other words, by firing a carbonic acid gas laser with a power density of around 1 to 6 kW/mm^2 for around 0.1 to 1 second, first the outside low melting point material will melt and vaporize, the periphery will soften and then the high melting point material causes melting and rising, providing a mechanical crimping state, fuses, and forms a composite of the two materials, making a strong joint. At this point, because just the laser beam is fired, the joint has processed joint can be achieved without any physical contact. This is very efficient, allowing the operation to be carried out extremely quickly.

With the holder for an inclined post for a magnetic tape travelling guide of the embodiment described above, a die-cast metal part can be used without post-processing, enabling the rationalization of costs.

Figures 4(a), 4(b) and 5 show other embodiments of the present invention. Figure 4 shows an example of a plate-like assembled joint such as a box type, while Figure 5 is an example of a cylindrical assembled joint. In each figure, one or more beams of laser light can be fired directly at the surface of the low melting point material 9, allowing the high melting point material 10 to be joined without contact. When a high degree of precision is required, the parts can be temporarily fixed using a jig, etc. Note also that it is possible to form joints even when the surface is not completely level or when there are gaps 8, and it is possible to simplify the joining process because the nugget step, which is required to increase strength when using spot or other welding techniques, can be omitted.

EFFECT OF THE INVENTION

As above, with this invention, the low melting point material and the high melting point material are placed in close proximity, temporarily fixed in place with a jig, etc. as necessary, and then the surface of the low melting point material is struck directly by the laser beam so that the positioning precision in assembly is assured by the jig, etc. and the joint is made without contact and very quickly while the two pieces are maintained in that state, making an easy and highly precise joining and assembly method. Moreover, because little precision is required for the individual parts themselves, they can be produced inexpensively, which offers advantages for mass production.

4. BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an oblique view of an inclined guide post used in a video tape recorder that explains a conventional method of joining a low melting point material with a high melting point material, Figures 2(a) and 2(b) are disassembly views of the parts of Figure 1, Figure 3 is an oblique view showing an embodiment of the method of joining a low melting point material with a high melting point material based on the present invention, Figures 4(a) and 4(b) are oblique and cross-section views that show other embodiments of the present invention, and Figure 5 is a cross-section diagram that shows yet another embodiment.

1: Holder; 2: Shaft; 3: Positioning assembly jig; 5: Jig

reference surface; 6: V reference surface; 7: Laser beam; 9: Part made from material with low melting point; 10: Part made from material with high melting point

Name of agent: Patent attorney Toshio Nakao and one other

[See source for figures]

Figure 1

Figure 2

Figure 4

Figure 3

Figure 5

次や組立用治具、8……治具台地面、9……下基準面、7……レーザビーム、9……低融点材質部品、10……高融点材質部品。

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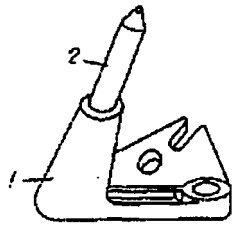
第1図



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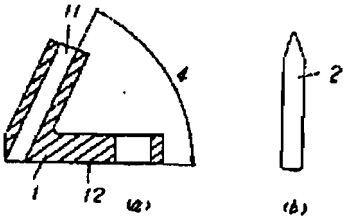

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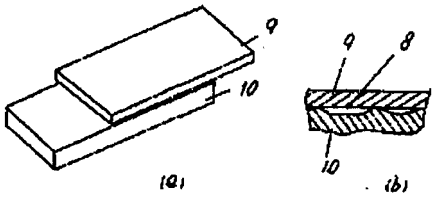
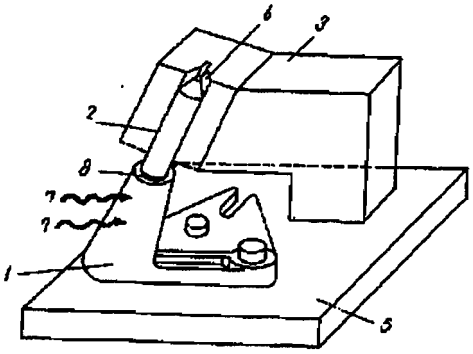


第3図



第5図